CLAIMS

1) A method for predictive maintenance of a cutting unit of an automatic machine; the cutting unit (1) comprising at least one cutting member (10) cooperating cyclically with a counter-member (11) to cut an article (2) fed between the cutting member (10) and the counter-member (11); the method comprising determining, with a given frequency, the value (V) of a characteristic quantity of the cutting unit (1) related to contact between the cutting member (10) and the counter-member (11); and the method being characterized by determining a first curve (14) for extrapolating the time pattern of the characteristic quantity value (V); and programming maintenance work on the cutting unit (1) when the first curve (14) is outside a given acceptance range.

2) A method as claimed in Claim 1, wherein the characteristic quantity is the energy produced by contact between the cutting member (10) and the counter-member (11).

3) A method as claimed in Claim 2, wherein the time pattern of the vibration produced by contact between the cutting member (10) and the counter-member (11) is determined; the energy produced by contact between the cutting member (10) and the counter-member (11) being determined as a function of the vibration produced by contact between the cutting member (10) and the counter-

member (11).

4) A method as claimed in Claim 1, wherein the characteristic quantity is the force, stress, pressure, impact, or acceleration, with which the cutting member (10) contacts the counter-member (11).

5) A method as claimed in Claim 1, wherein the characteristic quantity is a measurement of the vibration produced by contact between the cutting member (10) and the counter-member (11).

6) A method as claimed in any one of Claims 1 to 5, wherein the first curve (14) is an exponential curve.

7) A method as claimed in any one of Claims 1 to 6, wherein the acceptance range comprises a time-variable lower limit.

8) A method as claimed in Claim 7, wherein the lower limit of the acceptance range increases with time.

9) A method as claimed in Claim 7 or 8, wherein the lower limit of the acceptance range is defined by a second curve (15).

10) A method as claimed in Claim 9, wherein the second curve (15) is an exponential curve.

11) A method as claimed in Claim 9 or 10, wherein the second curve (15) is determined experimentally as the curve which best interpolates the set of relative minimum points of the characteristic quantity value (V) recorded just before maintenance work on the cutting unit (1).

12) A method as claimed in any one of Claims 1 to 11, wherein the acceptance range comprises a time-variable upper limit.

13) A method as claimed in Claim 12, wherein the upper limit of the acceptance range increases with time.

14) A method as claimed in Claim 12 or 13, wherein the upper limit of the acceptance range is defined by a third curve (16).

15) A method as claimed in Claim 14, wherein the third curve (16) is an exponential curve.

16) A method as claimed in Claim 14 or 15, wherein the third curve (16) is determined experimentally as the curve which best interpolates the set of relative maximum points of the characteristic quantity value (V) recorded just after maintenance work on the cutting unit (1).

17) A method as claimed in any one of Claims 1 to 16, wherein the characteristic quantity value (V) is determined during a first time interval and with a frequency given by a second time interval.

18) A method as claimed in Claim 17, wherein the first time interval is substantially 10 seconds, and the second time interval is substantially 10 minutes.

19) A method as claimed in any one of Claims 1 to 18, wherein the first curve (14) is determined using only the characteristic quantity values (V) following previous maintenance work on the cutting unit (1).

20) A method as claimed in Claim 19, wherein performance of maintenance work on the cutting unit (1) is indicated by a step in the pattern of the characteristic quantity values (V).

21) A method as claimed in Claim 20, wherein performance of maintenance work on the cutting unit (1) is indicated by a step of a value greater than a given first threshold value in the pattern of the characteristic quantity values (V).

22) A method as claimed in any one of Claims 1 to 18, wherein maintenance work on the cutting unit (1) is only actually programmed when the time lapse since previous maintenance work on the cutting unit (1) exceeds a given second threshold value.

23) A method as claimed in Claim 22, wherein the second threshold value is fixed.

24) A method as claimed in Claim 22, wherein the second threshold value is variable.

25) A method as claimed in Claim 24, wherein the second threshold value equals a given fraction of the time lapse between the last and last but one maintenance work on the cutting unit (1).

26) A method as claimed in any one of Claims 1 to 25, wherein the cutting unit (1) comprises a first drum (3) supporting a number of cutting members (10); and a second drum (7) cooperating with the first drum (3) and supporting a number of counter-members (11); each

cutting member (10) cooperating, in use, with a respective counter-member (11).

27) A method as claimed in Claim 26, wherein each value (V) of the characteristic quantity is determined as the total value over at least one complete turn of the drums (3, 7).

28) A method as claimed in Claim 26, wherein a corresponding intermediate value of the characteristic quantity is determined for each cutting member (10) during one complete turn of the drums (3, 7), and the value (V) of the characteristic quantity is determined as the average of all the intermediate values.

29) A method as claimed in Claim 28, wherein the intermediate values of the characteristic quantity are compared with one another to determine any inconsistency.

30) A method as claimed in any one of Claims 1 to 29, wherein the cutting member (10) is defined by a first blade, and the counter-member (11) is defined by a second blade.

31) A method as claimed in Claim 30, wherein, in use, the first and second blade (10, 11) slide one alongside the other to make a scissor cut.

32) A method as claimed in Claim 30, wherein, in use, the first and second blade (10, 11) cooperate end to end to make a nip-off cut.

33) A method as claimed in any one of Claims 1 to

32, wherein maintenance work on the cutting unit (1) comprises adjusting the position of the cutting member (10) with respect to the counter-member (11); a control unit (13) making an automatic power adjustment of the position of the cutting member (10) with respect to the counter-member (11), as a function of the first curve (14).

34) A method as claimed in Claim 33, wherein the control unit (13) determines the value of the adjustment to the position of the cutting member (10) with respect to the counter-member (11), as a function of the value of the first curve (14) when performing the maintenance work.

35) A method as claimed in Claim 34, wherein the control unit (13) determines the value of the adjustment to the position of the cutting member (10) with respect to the counter-member (11), as a function of the value of the first curve (14) when performing the maintenance work, and as a function of the location of the value of the first curve (14) with respect to the acceptance range.

36) A method as claimed in any one of Claims 1 to 32, wherein maintenance work on the cutting unit (1) comprises adjusting the position of the cutting member (10) with respect to the counter-member (11); when performing maintenance work on the cutting unit (1), a control unit (13) determining a recommended value of the

adjustment to the position of the cutting member (10) with respect to the counter-member (11), as a function of the first curve (14).

37) A method as claimed in Claim 36, wherein the control unit (13) determines the recommended value of the adjustment to the position of the cutting member (10) with respect to the counter-member (11), as a function of the value of the first curve (14) when performing the maintenance work.

38) A method as claimed in Claim 37, wherein the control unit (13) determines the recommended value of the adjustment to the position of the cutting member (10) with respect to the counter-member (11), as a function of the value of the first curve (14) when performing the maintenance work, and as a function of the location of the value of the first curve (14) with respect to the acceptance range.

39) A method as claimed in any one of Claims 1 to 38, wherein, if the first curve (14) is outside the acceptance range immediately following maintenance work on the cutting unit (1), this means the cutting member (10) needs changing as opposed to adjusting.

40) A method as claimed in any one of Claims 1 to 38, wherein, if the first curve (14) is close to the acceptance range immediately following maintenance work on the cutting unit (1), this means the cutting member (10) needs changing as opposed to adjusting.

41) A method as claimed in Claim 40, wherein the acceptance range comprises a lower limit increasing with time and defined by a second curve (15); if the first curve (14) is close to the second curve (15) immediately following maintenance work on the cutting unit (1), this means the cutting member (10) needs changing as opposed to adjusting.

42) A method as claimed in any one of Claims 1 to 41, wherein, in determining the value (V) of the characteristic quantity of the cutting unit (1), a compensation is made as a function of environmental and operating conditions of the cutting unit (1).

43) A method as claimed in Claim 42, wherein, in determining the value (V) of the characteristic quantity of the cutting unit (1), a compensation is made as a function of the operating temperature of the cutting unit (1).

44) A method as claimed in Claim 42, wherein, in determining the value (V) of the characteristic quantity of the cutting unit (1), a compensation is made as a function of the operating speed of the cutting unit (1).

45) A method as claimed in any one of Claims 1 to 44, wherein various operating characteristics of the cutting unit (1) are checked to determine any damage to the mechanical components of the cutting unit (1), and so determine whether variations in the values (V) of the characteristic quantity are produced by actual wear of

the cutting member (10) or by damage to the mechanical components of the cutting unit (1).

46) A method as claimed in any one of Claims 1 to 45, wherein predictive maintenance parameters are used to improve design of the cutting unit, comprising, non-limitatively, the materials for cutting, and the form or profile or action of the cutting members.